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ESSAY REVIEWS

Niels Bohr's *Collected Works*

*By Henk Kubbinga**

The last two volumes of Niels Bohr's *Collected Works* have recently been published by North-Holland Elsevier, in Amsterdam. These two volumes (Vol. 11, 2005; Vol. 12, 2007), edited by Finn Aaserud, assess Bohr's activities in politics over the period 1934–1961 and those pertaining to “popularization and people” over the years 1911–1962, respectively. In his foreword to Volume 12, Aaserud briefly reviews the history of the *Collected Works*. The series commenced under the general editorship of Léon Rosenfeld (1904–1974), the distinguished former collaborator of Bohr. The first volume came out in 1972; it was edited by J. Rud Nielsen, who would also see Volumes 3 (1976) and 4 (1977) through the press. Volume 2, on atomic physics, was prepared by Rosenfeld but had to wait for Ulrich Hoyer's editorial supervision before it appeared in print, in 1981. In 1977 Erik Rüdinger (1934–2007) became general editor for the project; Volume 5 (1984) was the first to appear under his charge. Klaus Stolzenburg (Calw-Stammheim), Jørgen Kalckar (Århus), Jens Thorsen (Århus), and Rudolf Peierls (Oxford) edited successive volumes. Stolzenburg focused on the emergence of quantum mechanics, 1924–1926 (Vol. 5); Kalckar on the foundations of quantum physics, 1926–1958 (Vol. 6, 1985; Vol. 7, 1996); and Thorsen on the penetration of charged particles through matter, 1912–1954 (Vol. 8, 1987); while Peierls oversaw nuclear physics, 1929–1952 (Vol. 9, 1986). In 1989 Finn Aaserud succeeded Rüdinger as general editor; he assisted Kalckar with Volume 7. The last three volumes appeared under Aaserud's supervision. Volume 10 (1999), dedicated to the idea of complementarity in the broad sense (1928–1962), was seen through the press by David Favrholdt. Volumes 11 and 12 were the collaborative efforts of Aaserud and his deputies Felicity Pors and Anne Lis Rasmussen. Reviews of one or more of the twelve volumes have been published at various times.¹ The present essay

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I am indebted to the Royal Danish Academy of Sciences and Letters for a travel grant and to the staff of the Niels Bohr Archive, Copenhagen, for its hospitality and help. I thank the *Isis* referee for valuable comments.

¹ Vol. 1 was reviewed by O. Klein in *Centaurus*, 1973, 18:93–96. Vol. 3: K. M. Pedersen, *ibid.*, 1978, 22:250–252; W. H. McCrea, *Physics Bulletin*, June 1977, p. 250; J. Dorling, *British Journal for the History of Science*, 1979, 12:100–102. Vol. 4: Pedersen, *Centaurus*, 1981, 25:250–252; L. M. Falikov, *Phys. Bull.*, Oct. 1977, p. 477; A. R. Mackintosh, *Fysisk Tidsskrift* (in Danish; I consulted an English version, submitted by Mackintosh to Aage Bohr on 4 Jan. 1977 and now part of the collection at the Niels Bohr Archive). Vol. 5: H. Reichenberg, *Physikalische Blätter*, 1987, 43:321–325. Vol. 7: L. M. Brown, *Isis*, 1999, 90:143–144. Vol. 10:

is intended as a review of the complete series.² I propose to discuss the main line of thought followed by the successive editors in preparing the volumes and to sketch, roughly, the contents of Bohr's *Collected Works*. In order to highlight its particularities, I shall draw parallels with related projects, especially the ongoing edition of Einstein's works (and correspondence), on the one hand, and the editions of the works of Wolfgang Pauli, Erwin Schrödinger, and Werner Heisenberg, on the other.³

A lot has changed in historiography since the publication of the collected papers of Pierre-Simon Laplace, James Clerk Maxwell, Ludwig Boltzmann, and Max Planck.⁴ Laplace was honored in the French fashion—that is, retrospectively, by an edition of his published works prepared under the auspices of the Academy of Sciences. At the time the works of Maxwell and Boltzmann appeared, a complete edition of a physicist's publications was still, in itself, a most rewarding enterprise, if only because it brought the texts—some of which were hard to access, having originally been published in the most disparate settings—together in one place with a consistent format. Historiography, as such, was not directly involved: Maxwell's and Boltzmann's papers were still of interest for the cutting-edge physics of the day. Maxwell's more philosophical papers—for example, his lectures before the British Association for the Advancement of Science—were included with his works in physics. Boltzmann, on the other hand, was lucky enough to have his popular writings collected separately.⁵ By the time the publication of Max Planck's papers was undertaken, roughly fifty years later, new standards were being created by the increasing number of professional historians of science, those of the post-World War II generation. In a way, however, the Planck project was launched too early: his *Abhandlungen und Vorträge* were still literally “collected works” in very much the same way those of Laplace, Maxwell, and Boltzmann had been—that is, they were presented without any introduction or explanatory annotation. Planck's science, though, already belonged to the past. His *Abhandlungen und Vorträge* therefore were (and remain) useful mostly for those who were (are) interested in the past of their science—that is, for practicing scientists and their retired colleagues. In a parallel stream, the new group of science historians aimed at a far broader public. Indeed, according to this new view, the work of Laplace, Maxwell, Boltzmann, and Planck is so foreign as to be barely readable even for later specialists; if collections of such work are to be prepared, then, the material ought first to be digested so that a secondary circle of potentially interested readers might be reached as well. In practice, this implied that the original papers, first, had to be put in context by way of an introduction and, second, ought to be explained through appropriate annotations or running

G. M. Shepherd, *Endeavour*, 2000, 24:180–181; Brown, *Isis*, 2000, 91:619–620. Vols. 1–3: S. Petruccioli, *Scientia*, 1978, 113:1053–1062. Vols. 1–4: R. Stuewer, *Isis*, 1984, 75:234–235.

² A Chinese translation, made by the late Ge Ge (1922–2008) of Beijing University, was well under way: Vol. 1 came out in 1986, Vol. 10 in 2001. At this time it is not clear whether Vols. 11 and 12 will appear in print.

³ Albert Einstein, *The Collected Papers*, ed. J. Stachel, M. Klein, A. J. Kox, J. Renn, R. Schulmann, et alia. (Princeton, N.J.: Princeton Univ. Press, 1987–); Wolfgang Pauli, *Collected Scientific Papers*, ed. R. Kronig and V. F. Weisskopf, 2 vols. (New York: Wiley-Interscience, 1964); Erwin Schrödinger, *Gesammelte Abhandlungen*, 4 vols. (Vienna/Braunschweig/Wiesbaden: Verlag der Österreichische Akademie der Wissenschaften and F. Vieweg, 1984); and Werner Heisenberg, *Gesammelte Werke/Collected Works*, ed. W. Blum, H.-P. Dürr, and H. Reichenberg, Ser. A: *Original Scientific Papers* (Berlin: Springer, 1985–), Ser. B: *Scientific Review Papers, Talks, and Books* (Berlin: Springer, 1984–), Ser. C: *Philosophical and Popular Writings* (Munich: Piper, 1984).

⁴ Pierre-Simon Laplace, *Oeuvres complètes*, 14 vols. (Paris: Gauthier-Villars, 1878–1912); James Clerk Maxwell, *The Scientific Papers*, ed. W. D. Niven, 2 vols. (Cambridge: Cambridge Univ. Press, 1890; rpt., New York: Dover, 1952–1965); Ludwig Boltzmann, *Wissenschaftliche Abhandlungen*, 3 vols. (Leipzig: Barth, 1909); and Max Planck, *Physikalische Abhandlungen und Vorträge*, 3 vols. (Braunschweig: Vieweg, 1958).

⁵ Ludwig Boltzmann, *Populäre Schriften* (Leipzig: Barth, 1905).

commentary. With this new audience in view, the papers of Maxwell have been masterfully re-edited, in the light of his correspondence, by Peter Harman.⁶

The new aims reflect the coming of age of the history of science as an academic discipline, characterized (for example) by official courses for undergraduates, by graduate programs for Ph.D. students, and by specialized institutions, periodicals, and congresses. That emancipation of the history of science as an independent discipline brought with it a debunking (*Entmythologisierung*) of science as such. The all-too-speculative generalizations of scientists, for whom history was but a tool that would help them seize the attention of an audience and who did not bother too much about the facts, were thus unmasked for what they were: sweeping statements of little explanatory value. Instead, it had come to be realized, insight into the development of a theory could help to bring about a better understanding of it—and not only for a secondary audience. A case in point is the quantum theory of Planck.⁷ In the standard accounts it is usually associated with classical atomism. The finite divisibility of matter is loosely put on a par with the “finite divisibility” of energy, which suggests that a discrete theory of matter could only be matched by a discrete theory of energy. This broad view, with its implicit appeal to the unrivaled authority of the Greek atomistic philosophers and the foggy nature of the notion of “atomism” itself, is, from a historiographical point of view, completely erroneous. Indeed, in reality, Planck’s theory derives directly from the kinetic theory of gases: the curves that showed up for black-body radiation looked like statistical distributions and, from a thermodynamic point of view, behaved as such—that is to say, they behaved like the velocity distributions for molecules as elaborated by Maxwell and Boltzmann. In fact, those velocity distributions had not even been experimentally demonstrated; that had to wait for Otto Stern (1920). The undeniable flaws in Planck’s theory, which are usually submerged in the “big picture,” resurface in the process of its historical elaboration, awaiting a real solution. So, by elucidating the actual emergence and development of a theory, the science historian contributes significantly to a better understanding of the actual state of that theory. It is evident, then, that preparing a new edition of Planck’s *Physikalische Abhandlungen und Vorträge* would be a challenging enterprise. Let me now consider successively the four projects I have chosen to gauge Bohr’s *Collected Works*, beginning with the edition of Pauli’s papers.

In terms of the new views about staging and context, the *Collected Scientific Papers* of Wolfgang Pauli (1900–1958) seem to fall somewhere between those of Boltzmann and Planck. They feature a “Preface” by the editors, Ralph Kronig and Victor Weisskopf; it is followed by the texts of virtually all of Pauli’s papers.⁸ Only one of these appears to be annotated, however: the rightly famous tract *Relativitätstheorie* (1921). On closer inspection, though, the notes in question seem to be those added by Pauli himself for the English translation published in 1958. Most oddly, then, these notes do not refer to the correct page numbers in the German text, and so, in the absence of that translation, they are no help in the reading of Pauli’s original paper. Given the (generally) highly intricate and thoroughly mathematical content of Pauli’s work, it seems clear that in the long run his *Collected Scientific Papers*, as they stand, will become all but unreadable.

⁶ James Clerk Maxwell, *The Scientific Letters and Papers*, ed. Peter Harman, 3 vols. (Cambridge: Cambridge Univ. Press, 1990–2000).

⁷ See Thomas S. Kuhn, *Black-Body Theory and the Quantum Discontinuity, 1894–1912* (Oxford/New York: Clarendon, 1978; rpt., Chicago: Univ. Chicago Press, 1987).

⁸ Vol. 1 contains Pauli’s books and contributions to books, Vol. 2 his journal articles, conference reports, and contributions to discussions.

Erwin Schrödinger's *Gesammelte Abhandlungen* present his contributions to statistical mechanics (Vol. 1), field theory (Vol. 2), and quantum theory (Vol. 3) and his general scientific and popular papers (Vol. 4) in stylishly bound volumes. His books are not included in the set. Each volume is succinctly introduced by Walter Thirring. The introduction to Volume 1, for instance, presents an account of Schrödinger's ideas before and after he took refuge in Ireland in only two pages. Generally, the reprints collected in Volume 1 were to lead to his monograph *Statistical Thermodynamics*, published in 1944. In Ireland Schrödinger was more or less isolated from the leading mathematicians of his day, and he gradually lost his feel for the avant-garde mathematics of the time. Thirring's essay, then, serves to supply the background that allows Schrödinger's development to be better understood. Otherwise, the various papers are presented in the original language (German or English) without further comment. What holds for Pauli's works, then, applies equally to those of Schrödinger: within a hundred years they will be incomprehensible, unless someone takes the trouble to introduce and annotate the texts.

My third point of reference is the ongoing Heisenberg project (1984–). It is in three series: Series A reproduces the original scientific papers; Series B the scientific review papers, talks, and books; and Series C the philosophical and popular writings. Typically, not only the published papers, but also those that were prepared for publication but remained in manuscript (e.g., Heisenberg's report for the Eighth Solvay Conference of October 1939), are reproduced. Correspondence, memoranda, and incomplete manuscripts have been omitted. The edition includes both a complete bibliography and a biographical sketch by David Cassidy. Compared to the works of Schrödinger, there is evident progress in terms of preparation and presentation: each group of papers is both introduced to put it in context and annotated to make it understandable. Thus Volume 1 of Series A assesses four topics: hydrodynamic stability and turbulence theory (1922–1948), atomic and molecular structure (1922–1925), quantum mechanics (1925–1927), and applications of quantum mechanics (1926–1933). The group of papers on quantum mechanics is preceded by an "annotation" by B. L. van der Waerden and H. Reichenberg that in fact reads like an "introduction and commentary." For example, the celebrated paper "Quantum Theoretical Re-interpretation of Kinematic and Mechanical Relations" (1925; pp. 382–396), which founded quantum mechanics, is put in perspective on pages 333–345. Inconsistencies in Heisenberg's notation, unexplained notions, and several tacitly made assumptions are fittingly elucidated. On the whole, the highly qualified specialist in today's quantum mechanics will find just the elements necessary to ponder Heisenberg's innovations thoroughly, while the more modestly armed relative outsider will have a reasonable chance to understand the basic tenets.

Compared to the editions of Pauli, Schrödinger, and Heisenberg, the *Collected Papers* of Albert Einstein—well under way since 1987—represent more and more the acme of editorial perfection in what, by now, may justly be called an American tradition.⁹ The editors have chosen to proceed in a primarily chronological order: the edition begins with the Swiss years—that is, the period up until 1914. Einstein's papers are reproduced in facsimile, directly from the sources. They are neatly introduced and annotated, drawing on his correspondence. The bulk of that correspondence is treated, next, in much the same way. Volume 10 of the edition was published in 2006. It reproduces Einstein's correspondence, from Berlin, in May–December 1920. It is indeed a matter of justice to hail,

⁹ This perfection is epitomized by Charles C. Gillispie, ed., *Dictionary of Scientific Biography*, 16 vols. (New York: Scribner's, 1970–1980); and *The Papers of Joseph Henry*, as edited, successively, by Nathan Reingold and Marc Rothenberg (Washington, D.C.: Smithsonian Institution Press, 1972–2007).

here, the growing degree of sophistication to which Einstein's *Collected Papers* bear witness. The edition still has a long way to go. Nonetheless, assessing Einstein's development at the beginning of his career, on the eve of his *annus mirabilis*, 1905, is now a straightforward matter.¹⁰ What I hinted at in the case of Planck appears to hold equally for Einstein: he, too, struggled with the physical implications of the kinetic theory of gases—more particularly the molecular theory of matter. Indeed, just like Planck, Einstein testifies to the omnipresence of molecularism as a guiding principle in early twentieth-century physics. This is but one example of how deep-lying evidence that would otherwise go unnoticed is teased out thanks to the scholarly endeavors of the distinguished editors. Here I would respectfully single out John J. Stachel, the editor in charge of Volume 2, which reproduces Einstein's writings from the period 1900–1909.

The *Collected Works* project under review here was initiated soon after Bohr's death, in 1962, through a joint effort of the American Physical Society and the American Philosophical Society. At that time a Joint Committee of these two societies was guiding the well-known project Sources for History of Quantum Physics, financed by the U.S. National Science Foundation and directed by the late Thomas S. Kuhn.¹¹ Several collections of correspondence and documents by the founding fathers were brought together under the general heading "Archive for the History of Quantum Physics." One such collection centered on Bohr's almost complete set of papers, kept at what was to become, in 1985, the Niels Bohr Archive (NBA) at Blagdemvej, Copenhagen. Bohr's collection embraced not only his publications but also draft versions of them, together with texts that were never published. Moreover, Bohr's own development can be followed through his carefully archived correspondence, also kept at the NBA. As we will see, the successive editors of the *Collected Works* have made good use of this fortunate circumstance. It was Léon Rosenfeld, a student and early biographer of Bohr, who first took charge of the huge operation. At the time Rosenfeld was a professor at NORDITA, the Nordisk Institute for Theoretical Atomic Physics—the Scandinavian umbrella organization whose administrative center of gravity was housed at the Niels Bohr Institute (NBI). He not only taught physics but also gave courses on the (recent) history of his discipline. Rosenfeld had founded the journal *Nuclear Physics*, and its editorial office was still housed at the NBI. The North-Holland Publishing Company, which issued *Nuclear Physics*, appeared interested in publishing Bohr's *Collected Works*. Crucially, the Carlsberg Foundation was generously willing to fund the enterprise—as it had earlier supported so many of Bohr's own activities. The official agreement, dated 6 February 1969 and signed by Aage Bohr on behalf of the Niels Bohr Institute, foresaw an edition in "approximately seven volumes of about five hundred pages each," with Léon Rosenfeld as editor-in-chief.¹²

The *Collected Works* incorporate, to begin with, Bohr's successive publications, lectures, and the like, grouped according to the subject matter of the volumes (given above) and where necessary translated into English.¹³ Because the aim of the project is to render

¹⁰ See Abraham Pais, *'Subtle Is the Lord . . .': The Science and Life of Albert Einstein* (Oxford: Oxford Univ. Press, 1982).

¹¹ For a survey see, particularly, T. S. Kuhn, J. L. Heilbron, P. L. Forman, and L. Allen, *Sources for History of Quantum Physics: An Inventory and Report* (Memoirs of the American Philosophical Society, 68) (Philadelphia: American Philosophical Society, 1967).

¹² For details see *En rapport om Arkivets tilblivelse, omfang og virksomhed med en opgørelse over akutte behov for materialets bevarelse samt planer for arkivets fremtid på længere sigt*, dated April 1983 and kept at the Niels Bohr Archive.

¹³ All non-English texts except those in German and French are accompanied by an English translation.

both the contents and the course of their development comprehensible for posterity, the volumes include successive draft versions and illuminating quotations from the correspondence. The result is, most of the time, an organic whole that enables the modern reader to follow directly in the footsteps of Bohr. One example among many is the celebrated trio of papers “On the Constitution of Atoms and Molecules,” published in Volume 2. In his “Introduction” Ulrich Hoyer (University of Münster), the editor of the volume, first presents the text (in English translation) of a letter from Bohr to his brother Harald, dated 19 June 1912, in which he announces that he has found out “a little about the structure of atoms.” The letter in question is published in Volume 1 (pp. 558–559) in both the Danish original and an English translation. On the basis of surviving materials kept at the Niels Bohr Archive, each one specified in a footnote, Hoyer then sets out to reconstruct the successive stages of Bohr’s theory. He makes use, too, of the most authoritative historiography—in this case John Heilbron and Thomas Kuhn’s wonderful paper “The Genesis of the Bohr Atom” and his own *Die Geschichte der Bohrschen Atomtheorie*.¹⁴ From the beginning, it appears, the atom was conceived of as a tiny nucleus surrounded by orbiting electrons. The smallest atom, hydrogen, had one such electron and served as a model. Hoyer next enumerates the boundary conditions—which he somewhat awkwardly calls “laws”—Bohr had to cope with, including the probable periodicity in the atomic volumes and the empirical fact, established by the Braggs, that foils of heavier metals absorb X-rays to a lesser degree than those of lighter ones. A fragment of a reassuring letter from a father-like Ernest Rutherford, dated 11 November 1912, exhorts Bohr not to hurry too much, since no other physicist was working on the subject; the letter is reproduced in its entirety at the end of Volume 2. With the Periodic System in mind, Bohr gradually translated the periodicity observed by the chemists into concentric coplanar rings filled with an increasing number of electrons and characterized by abrupt changes in stability. The admission of a “permanent” state for an atom implied, in more physical terms, the constancy of the angular momentum of each electron. Bohr reported this to Rutherford on 31 January 1913. In the meantime, he had come across a theory suggested by John William Nicholson, who in June 1912 had associated the spectral lines of stars with out-of-plane oscillations of revolving electron rings and, crucially, Planck’s radiation theory. Again, Hoyer refers to Bohr’s correspondence with his brother Harald (a Christmas card of 23 December 1912) and with Rutherford (the letter of 31 January 1913). Nicholson’s radiating atoms were, according to Bohr, unlike the more down-to-earth ones of chemistry, his own “permanent” ones. Hoyer next refers to letters from Bohr to C. W. Oseen and Georg von Hevesy, dated 5 and 7 February 1913, both in the same mood. Bohr was at Manchester at the time, and during a casual discussion with the spectroscopist Hans M. Hansen he learned, perhaps for the first time, of the spectral formula that the Swiss mathematician Johann Balmer had deduced from the numerical data of the hydrogen spectrum as produced by the light of a gas discharge tube—that is, for hydrogen atoms in states corresponding to Nicholson’s. In his formula, a generalization of one by Johannes Rydberg, Balmer had related the first line of lowest wave number with the next four successive lines, and Bohr must have recognized its blueprint-like character as to the possible states of the one electron in the hydrogen atom. Already, on 6 March 1913, he sent Rutherford the fully elaborated text of the first instalment of what was to become a

¹⁴ John Heilbron and Thomas S. Kuhn, “The Genesis of the Bohr Atom,” *Historical Studies in the Physical Sciences*, 1969, 1:211–290; and Ulrich Hoyer, *Die Geschichte der Bohrschen Atomtheorie* (Weinheim: Physik-Verlag, 1974) (this volume grew out of Hoyer’s *Habilitation* thesis [Univ. Stuttgart, 1972]).



Figure 1. Bohr and Rutherford back-to-back during the annual boat race between the students of Cambridge and Oxford on 24 March 1923. Courtesy: Emilio Segrè Visual Archive of the American Institute of Physics.

trilogy, to be submitted to the *Philosophical Magazine*. In it he succeeded in deducing the numerical value of Planck's constant from the charge and mass of an electron and the constant that was central to both Rydberg's and Balmer's formulas. In other words, he independently deduced a rather accurate value for what was already recognized as one of the most fundamental constants of physics.

This is, of course, not the place to delve into the physical and mathematical details. I content myself with sketching in the background that Hoyer, in exemplary fashion, presents in order to bring the very busy month of March 1913 to life. Rutherford answered Bohr's letter of 6 March on the 20th: the text was too long, he wrote; it should be cut down. But Bohr had already sent him a second, considerably longer version. Again, on 25 March, Rutherford emphatically suggested that Bohr abbreviate his presentation as much as possible. Bohr, though, had not even waited for Rutherford's second answer; keen to see his paper appear in print, he had booked passage from Esbjerg to Harwich in order to convince his patron in a face-to-face meeting. We may safely surmise that Rutherford was charmed by such youthful candor. (See Figure 1). In any case, Bohr succeeded: the first instalment of his paper, entitled "On the Constitution of Atoms and Molecules" and dated 5 April 1913, appeared in the July issue of the *Philosophical Magazine*. From the foregoing, it may be seen how Hoyer, under the general editorship of Rosenfeld, brilliantly accomplished his task: to illuminate and elucidate those first months in the life of a revolutionary new theory, benignly taking into account the self-confident, stubborn way in which the inventor won the support of his illustrious mentor. And the care and specificity that I have detailed for this particular case hold for the *Collected Works* as a whole. It is, therefore, the natural starting point for any historian of science interested in the life and times, the endeavors and exploits, of the great physicist that

was Niels Bohr. Through the generous work of Rosenfeld and Hoyer and their successors, we are now indeed able to look much farther and to understand much more.

* * *

There has been some criticism of collected works as a historiographic genre. Lewis Pyenson, for instance, in reviewing the first volume of the Einstein project, justly drew attention to a rather large number of more or less serious omissions and inaccuracies and asked, in consequence, whether this kind of endeavor indeed merited the financial backing of the supporting institutions. In his view, the huge amounts of money involved could better be used to fund history of physics activities more generally.¹⁵ I think, however, that Pyenson was wrong to suggest that in these cases it usually comes down to a choice between related alternatives. Instead, it seems to me that projects like those on Bohr and Einstein have the power to generate *new* money—money that would otherwise have been spent, for example, on prestigious editions in the history of art. Honoring scientists like Bohr and Einstein by publishing their collected works is self-rewarding in the sense that the history of science as a discipline profits directly from their stature. Long-term research programs of this kind are indeed likely to produce, by themselves, new *history of science*—namely, by enabling students and specialists alike to partake in the activities of the project (collecting data and documents; working on their translation, interpretation, and edition; reading proof; etc.). In so doing they create an atmosphere of scientific conviviality in which the renowned specialist, the future Ph.D. student, and even the interested outsider may flourish, to the benefit of the discipline as a whole. As a former member of the team directed by René Taton and Pierre Costabel in Paris, I speak from experience: on my way to the Ph.D. I felt privileged in being allowed to contribute all kinds of details to the ongoing editions of the works of Mersenne, Euler, and Lavoisier.

This essay review of Bohr's *Collected Works*, therefore, is also a plea on behalf of the genre as such, from the simple reproduction of original papers to the most meticulously introduced and annotated edition of a coryphaeus's *oeuvre*. As the Maxwell case shows, simple reproduction may always be followed, under more favorable circumstances, by a more elaborate version. Whatever form they take, however, these editions naturally lead, directly or indirectly, to a better understanding of the past by facilitating the writing of biographies of scientists and case studies of theories, experiments, and instruments. It is our duty as educators, of course, to guarantee that the secondary sources—for example, Pyenson's indispensable review—are respected and duly consulted by the next generation. My larger point is that, in practice, in most cases no one is willing to go to the trouble of publishing more or less complete editions of scientists' papers. Modern scientists, seemingly convinced that their own "state-of-the-art" knowledge will in the end prove transitory—or perhaps simply for reasons of jealousy—more often than not disdain such projects. Modern historians, at the other end of the spectrum, not hampered by any serious scientific education, often shamelessly claim that the history of, say, physics can be—or even *ought* to be—formulated in a way such that even they are able to understand what it is all about. In both of these characterizations, I speak from experience. In judging any collected works project, we should take these odds against them into account. Considering all this, it seems nothing short of a wonder that the *Collected Works* of the gentleman-scientist Niels Henrik David Bohr have been published at all—and in such an elegant and useful format.

¹⁵ Lewis Pyenson, "Just the Facts," rev. of *The Collected Papers of Albert Einstein*, Vol. 1, ed. John Stachel, *Isis*, 1989, 80:129–135.